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IS Series Current Sense Transducer
Application Information

1 Scope

This application note provides background information and techniques on how to apply a low cost contactless current sensor in applications that use a busbar. The sensors come in three sizes/ranges to cover a wide range of currents. The sensor features 8mm creepage, high isolation, low cost, fast response and high bandwidth. The technology is easy to install in challenging mechanical applications with tight dimensions.

2 Introduction

The IS series of contactless current sensors is a custom ASIC based hall effect device designed to operate without the need for the core and winding commonly used in current sensors. The current sensors can be applied in a wide range of busbar applications with currents ranging from 50A up to over 1,200A. The devices feature low insertion loss, high isolation, fast response, wide bandwidth (0-90 kHz), small size and easy assembly. Programmable features include output type, output filters and customizable current range.

The simplified design consists of a PCB assembly, shield and a mechanical package to integrate the component parts. Thus enabling a lower cost than traditional current sensors while offering performance between typical open loop and closed loop designs.

3 Current Sensing Applications

For medium and large volume applications in industrial and automotive applications, electrical currents are either measured by resistive shunts, current transformers or by magnetic sensors. Although shunts are widely used due to low component price, magnetic sensors bear significant advantages on the system level. Current transformers require a time varying or AC current and cannot be used to measure direct current, (DC), The main advantages of current sensors are:

- Magnetic sensors operate contact-less, while providing galvanic isolation between current conductor and sensor.

- Magnetic sensors convert very little electrical power into heat which costs money and needs to be dissipated safely.
- Hall effect magnetic sensors can be integrated in standard CMOS circuits to provide high level output signals and they can be programmed inside the system to yield a calibrated output. Moreover they can be fitted with standard interfaces for communication.

4 Sizing

The current sensors come in three sizes to cover a wide current range and fit a number of busbars. Each is designed to work with a different sized busbar. The ISA is designed to fit a max ½ inch busbar and measure up to 522 amps. The ISB is designed to fit a max ¾ inch busbar and measure up to 678 amps. The ISC is designed to fit a max 1 ½ inch busbar and measure up to 830 amps. The thickness of the busbars are variable with a max thickness of ¼ inch for each with no loss in accuracy. There are limits on the minimum width of the busbar for each size. Please ask an ICE engineer for details.

5 Shield

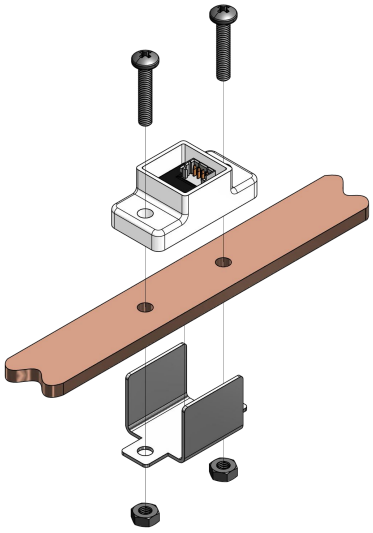
By adding a u-shaped shield two objectives can be met. First the magnetic flux density is concentrated within the shield. Due to the smaller magnetic resistance, (μr from air is smaller than the μr of the shielding material) a higher magnetic flux density is generated in the gap of the shield. Simulations show that the magnetic flux density is about doubled with the shield when the same current is applied. This helps the current sensors to measure low current levels when compared to the overall current range of the sensors. Secondly the shield helps protect the sensor from stray EMI fields.

6 Linear and Extended Ranges

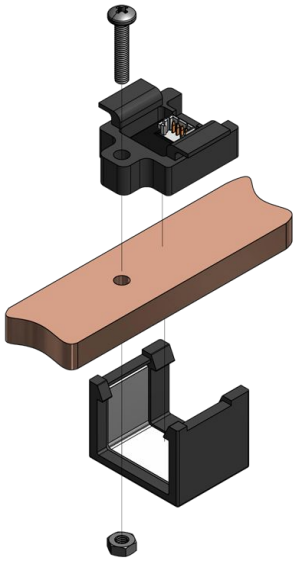
The current sensors are specified with two current ranges; I_{PL} and I_{PE}. I_{PL} or linear current range is the range within which the current sensor measurements are within the specified 0.1% linearity. In many applications there is a nominal current to be measured but a higher current to be measured in startup or in failure situations. I_{PE} extends the current range when accuracy is not as important but some resolution at higher currents is needed.

7 Busbar Attachment

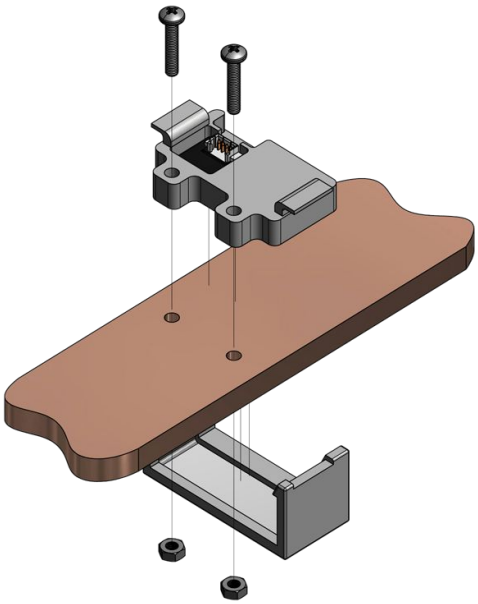
The current sensors are attached using standard hardware. For the A version the busbar is sandwiched in between the busbar and the plastic housing. There are attachment points at both points of the housing to provide a secure connection and to prevent potential stress to the shield. In applications with vibration the addition of a lock washer is recommended.



For the B version current sensor the upper half of the sensor is attached to the busbar using standard hardware. The lower half of the housing is then clipped to the upper half for a secure connection. The lower housing also serves as protection for the shield.



For the C version current sensor the upper half of the sensor is attached to the busbar at two points using standard hardware. The lower half of the housing is then clipped to the upper half for a secure connection. The lower housing also serves as protection for the shield.



8 Temperature Output

The current sensors are equipped with a temperature output to monitor the temperature of the current sensor environment. The temperature sensor is located above the busbar within the potting material at the top of the sensor. This temperature could be used in an external algorithm to calibrate the sensor output accuracy over the application temperature range.

9 High Current Application Example

In order to measure high currents without the need for a very wide shield, another option is to split the busbar so that only a fraction of the total current is measured by the sensor (exhibit 1). With this configuration, the shield can be made much smaller and lower cost.

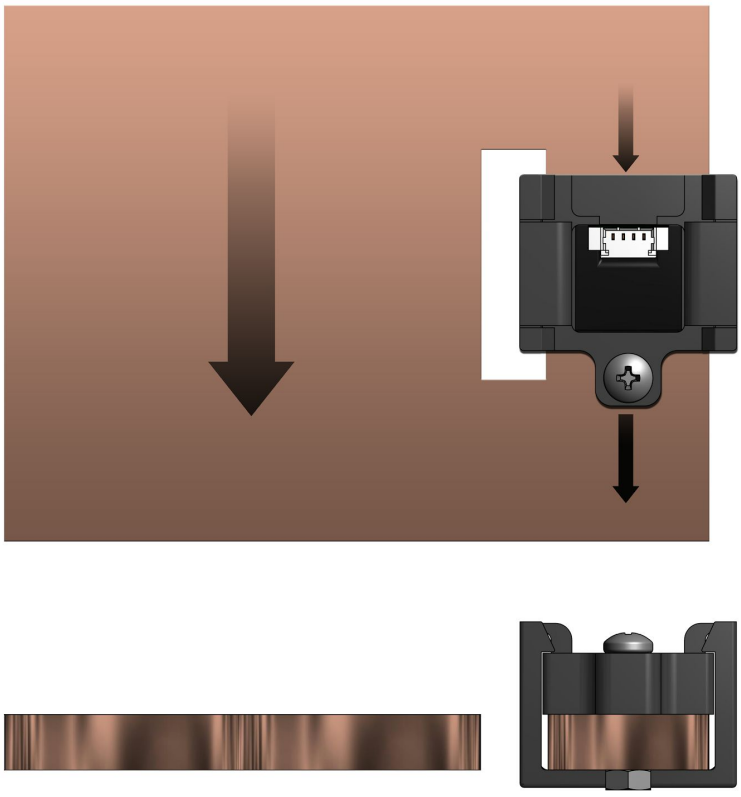


Exhibit 1

Considering an application with a current of 1,600A flowing in a busbar of 88mm (width). A straightforward solution would be to add a current sensor around the entire busbar resulting in a larger current sensor. A smaller solution can be achieved by adding an 8mm slot that is 20mm from one side of the busbar (exhibit 2). The resulting current in the 20mm section is only 400A (¼ of the total busbar cross section). The ISB current sensor can be applied to the 20mm section of the busbar and can be scaled to measure the 1,600A flowing in the busbar.

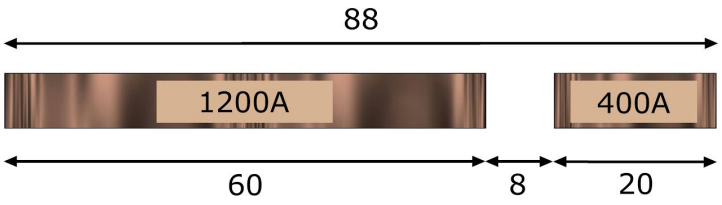


Exhibit 2